

THE WEATHER AND CIRCULATION OF AUGUST 1969

A Month With Record Warmth in the West

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1. MEAN CIRCULATION

Midtropospheric westerlies in the western portion of the Northern Hemisphere were below normal south of about 45° N. during August. This was accompanied by retrogression of several middle- and low-latitude circulation features during the month, a fairly common development when the westerlies dwindle to their low point of the year.

July's east Pacific upper ridge (Andrews, 1969), which has had a long-term history of retrogression, continued its westward motion in August as it moved to the mid-Pacific and phased with a preexisting blocking ridge over northeastern Siberia (fig. 1). The northwesterly flow thus established over a wide latitude band was associated with the southward motion of the Arctic Low north of Alaska and the development of a vigorous Gulf of Alaska trough. Downstream from this trough, amplification spread to the western U.S.-Baffin Island ridge and the eastern North American trough. Low-latitude trough and ridge positions over the United States represent retrogression from July positions. Over the Atlantic, July's mean Low remained about stationary through August, but upper level heights built strongly over Scandinavia, resulting in a

strong blocking anticyclone in that area. To the east of this ridge, the mean trough progressed to central Asia.

The relation of the atmospheric circulation of August (figs. 1, 2) to monthly mean brightness as measured by the ESSA 9 satellite (fig. 3) is of interest. The three abnormally strong ridges at high latitudes over Baffin Island, Scandinavia, and northeastern Siberia are all represented by relatively low brightness areas on the satellite photo. This is a response to lack of cloudiness in these areas and graphically depicts the relatively large influx of solar radiation to the surface in these areas of long summer days. Other areas of minimum monthly cloudiness are in northern United States from the Cascade Range to the Great Lakes, where anticyclonic conditions south of the main belt of westerlies prevailed, and in the subtropical oceanic anticyclones. Bright areas associated with major areas of cloudiness during the month include the North Atlantic and North Pacific storm tracks, the area south of the Scandinavian blocking High, coastal regions in advance of the trough in southeastern United States, and the Tropics. Another major area of cloudiness, less obviously attuned to the circulation, is found over the

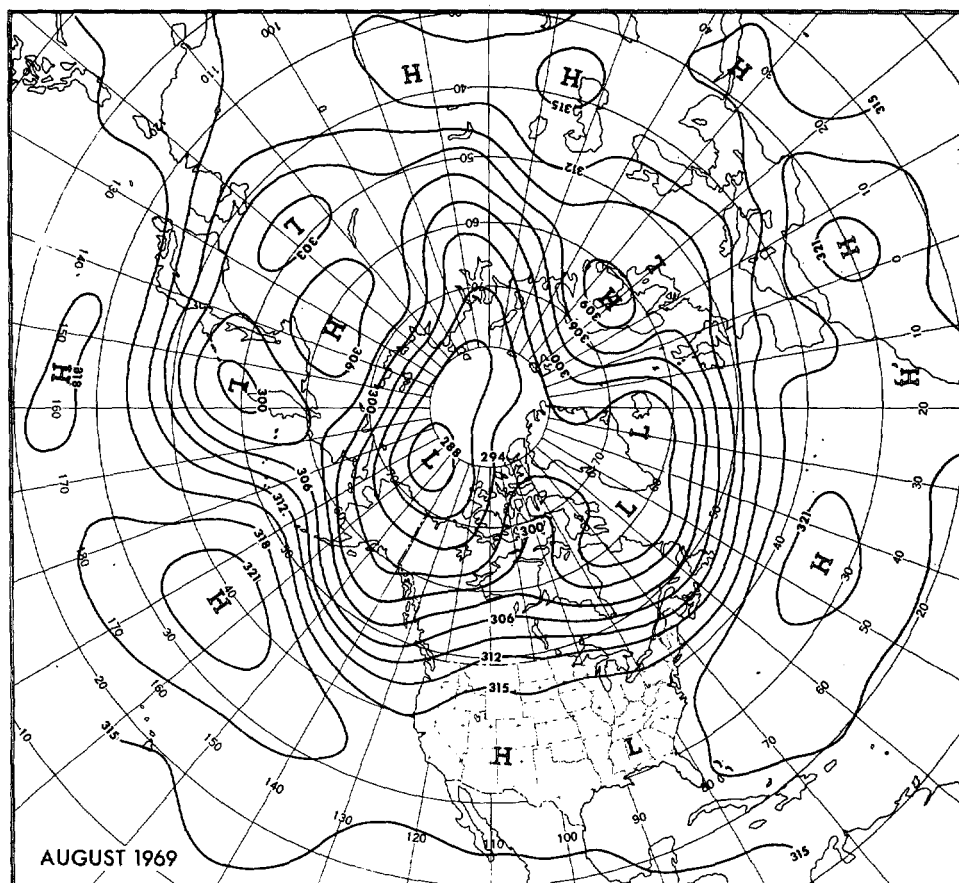


FIGURE 1.—Mean 700-mb contours (decimeters) for August 1969.

Pacific to the southwest of California. Interestingly enough, this cloudy area showed up in averages of TIROS nephanalyses for the summer of 1962 (Clapp, 1964) and

for August of 1965 and 1966 (Sadler, 1968) and is described by Sadler as stratus and stratocumulus sheets over the cold water off the west coast of North America.

2. TEMPERATURE

Amplification of the western North American ridge during August, with accompanying deflection of the westerlies to the north, was associated with prevailing fair weather and warm temperatures (fig. 4) over most of the western half of the Nation and along the northern border from the upper Mississippi Valley through New England. Well above normal sunshine amounts were reported from such diverse locations as San Francisco, Calif.; St. Cloud, Minn.; Buffalo, N.Y., and Boston, Mass. Record high average temperatures for the month were observed at Ely and Las Vegas, Nev.; Phoenix, Ariz.; El Paso, Tex.; Milford, Utah; Grand Junction and Pueblo, Colo.; and Lander, Wyo. Elsewhere, near-record August warmth was experienced at Glasgow, Mont.; Bismarck, N. Dak.; Duluth, Minn.; Marquette, Mich.; Burlington, Vt.; Portland, Maine; and Boston, Mass.

Below-normal average temperatures for the month were largely confined to the southeastern quarter of the Nation in the vicinity of the upper level mean trough. The prevalent cloudiness in this area (fig. 3) was a major factor in producing the low temperatures. Columbus, Ga., reported the coldest August of record, while near-record cold was observed at Wilmington, N.C.

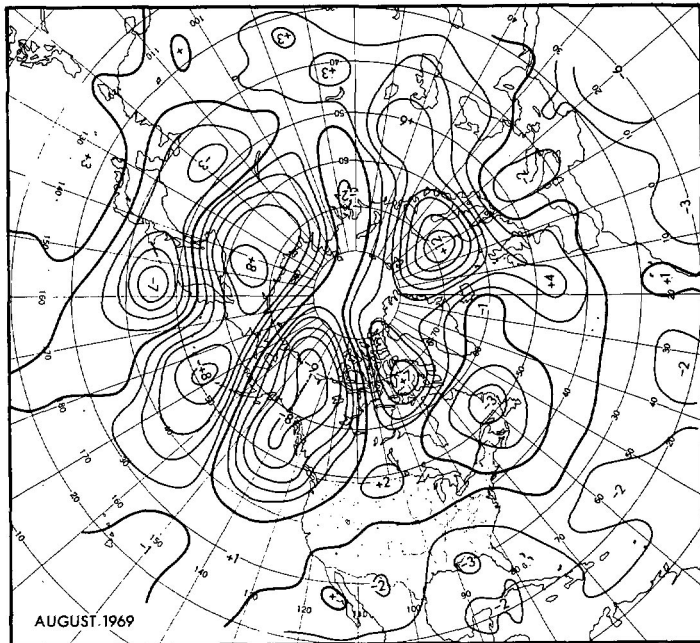


FIGURE 2.—Departure from normal of mean 700-mb heights (decimeters) for August 1969.

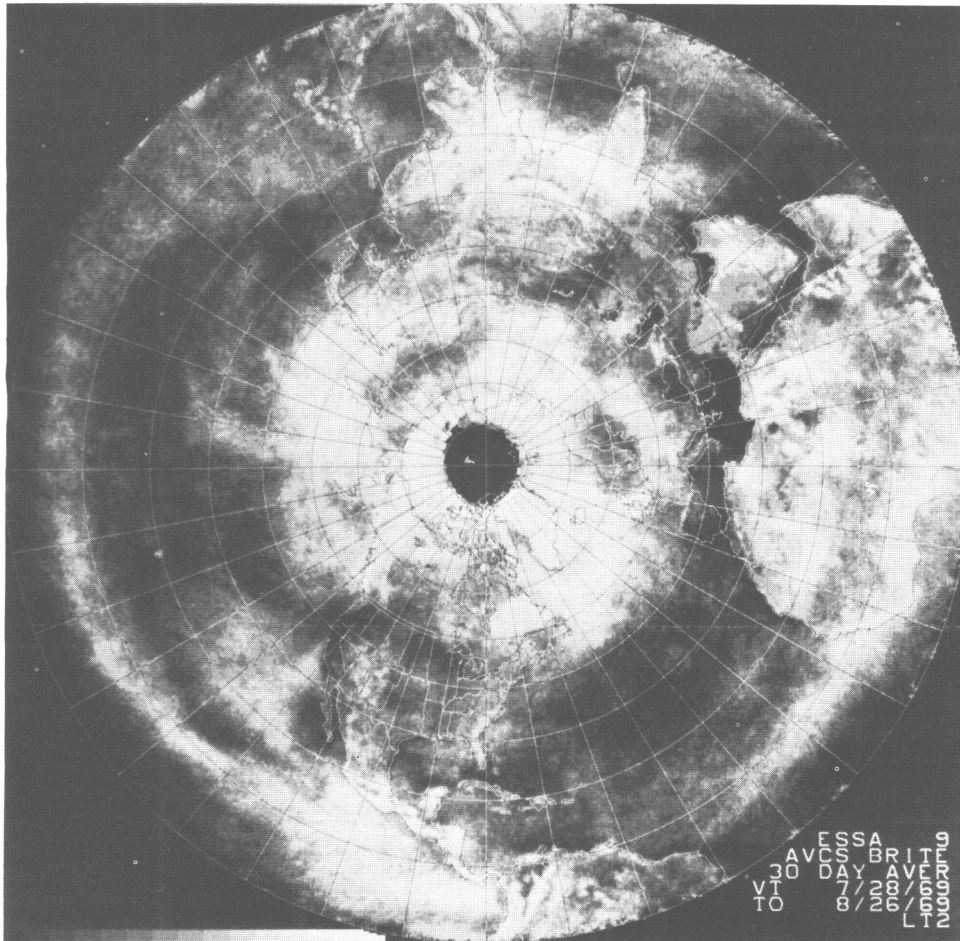


FIGURE 3.—Mean brightness composite of daily photographic observations from the ESSA 9 satellite for July 28–Aug. 26, 1969.

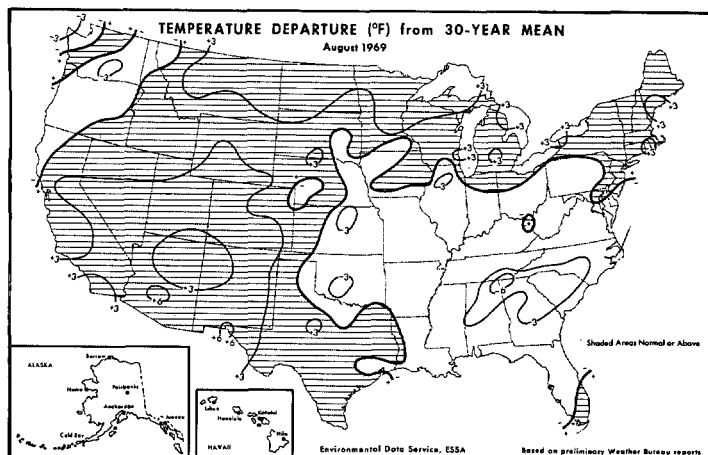


FIGURE 4.—Departure from normal of average surface temperature ($^{\circ}\text{F}$) for August 1969 (source, Environmental Data Service, 1969).

3. PRECIPITATION

As is generally the case in summer, precipitation and temperature anomaly patterns were highly correlated. The West and North received generally less than normal precipitation, while above-normal totals were largely confined to the southeastern quarter of the Nation, the location of the monthly mean trough (fig. 5). Precipitation in northern New England as well as the Far Northwest was associated with storms imbedded in the westerlies. Record or near-record dryness was reported from the Cascades of Washington and Oregon eastward across the Northern Plains to the Great Lakes and Ohio Valley. Record low totals for August were observed at Walla Walla, Wash.; Glasgow, Mont.; Dubuque, Iowa; Ft. Wayne, Ind.; and Flint, Mich. It is interesting to note how closely the area receiving less than half the normal August precipitation corresponds with the dark area on the monthly mean brightness map (figs. 3, 5).

4. VARIABILITY WITHIN THE MONTH

Weekly distributions of temperature and precipitation accompanied by appropriate 5-day mean 700-mb maps are shown in figures 6 through 9. Amplification of the wave pattern over North America in response to Gulf of Alaska deepening is well illustrated in figures 6 through 8. Subsequent downstream spread of the amplification over the Atlantic, Europe, and western Asia can be seen on figures 8 and 9. Toward the end of the month (figs. 8, 9) the northeastern Siberian ridge retrograded, producing strong cyclogenesis and increasing westerlies over the central Pacific, accompanied by flattening and progression over North America and the Atlantic. Persistence of the overall temperature pattern throughout the month undoubtedly contributed to the record and near-record warmth in the West and North. Highest temperatures in the Northern Plains occurred during the last half of the month (figs. 8, 9) when a strong upper ridge was over and to the east of the area. Helena, Mont., reported highest temperatures for so late in the season on August 23 (106°F) and August 24 (110°F), as did Boise, Idaho, on August 23 (107°F). Temperatures were high in Texas until the final week of the month (fig. 9) when the progressing upper ridge brought abundant moisture, cloudiness, and heavy precipitation to that area.

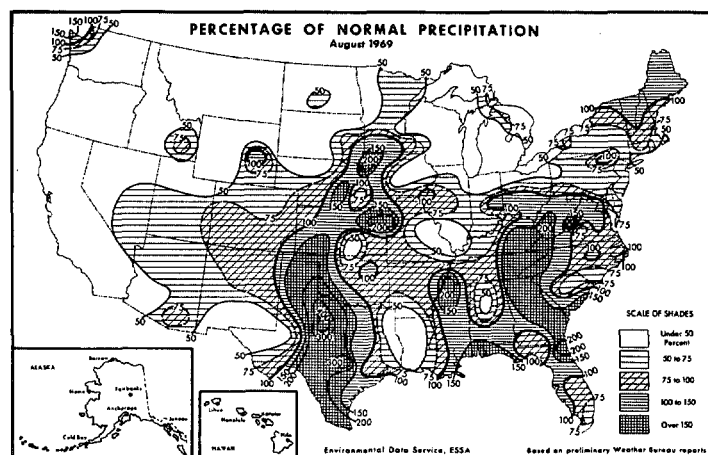


FIGURE 5.—Percentage of normal precipitation for August 1969 (source, Environmental Data Service, 1969).

Early in the month, when the upper westerlies were near the northern border of the United States (fig. 6), a vigorous cold front brought tornadoes to the North Central States. Greatest damage occurred in Minnesota on August 6. The crescent of heavy rainfall from Mississippi to Kentucky to Virginia on August 18–24 (fig. 8) clearly depicts the path of hurricane Camille. Cessation of the rainy regime in much of the East came in the final week of the month (fig. 9) when the progressing upper ridge moved to that area, replacing the earlier persistent trough.

5. TROPICAL STORM ACTIVITY

This was an active month for tropical storms in the Atlantic. A total of six tropical storms was observed, four of which reached hurricane intensity.

Tropical storm Anna was recurving northward off the east coast during the first few days of the month, caught up in the flow between the mean trough over the eastern United States and the strong Atlantic anticyclone (fig. 6).

The Atlantic High continued strong through the week of August 11–17 (fig. 7), during which time hurricanes Blanche, Camille, and Debbie were generated. Blanche moved along much the same path as Anna, but reached hurricane intensity only upon recurvature east of Hatteras on August 11. Camille, one of the most intense hurricanes to strike the United States, moved on a more westerly track, reaching hurricane intensity on August 15 near western Cuba and crossing the Gulf Coast near the eastern U.S. trough location (fig. 7). Subsequently, it moved northward to Kentucky before coming under the influence of a progressing midlatitude trough (figs. 7, 8), which steered the degenerating storm eastward over Virginia. In addition to extensive damage from 15- to 25-ft storm-driven tides and winds gusting to 190 mi hr^{-1} along the Gulf Coast, Camille produced very heavy rains in transit over the Appalachians, causing flash flooding in southeastern West Virginia and southwestern Virginia. Storm totals of 27 to 31 in. in less than 24 hr in western Virginia appear reliable. Extremely heavy precipitation along the James River Basin brought the most severe flooding to the James River and its tributaries in nearly a century. Debbie reached hurricane intensity on August 16 about 600 mi east of the Lesser Antilles. After curving west-northwestward for several days, Debbie was caught up

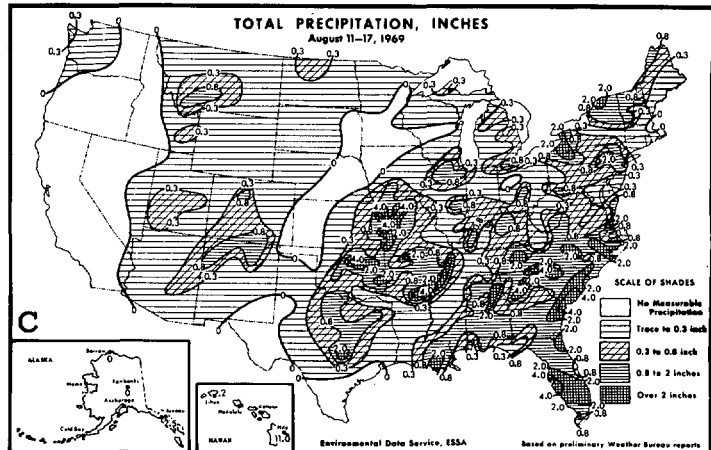
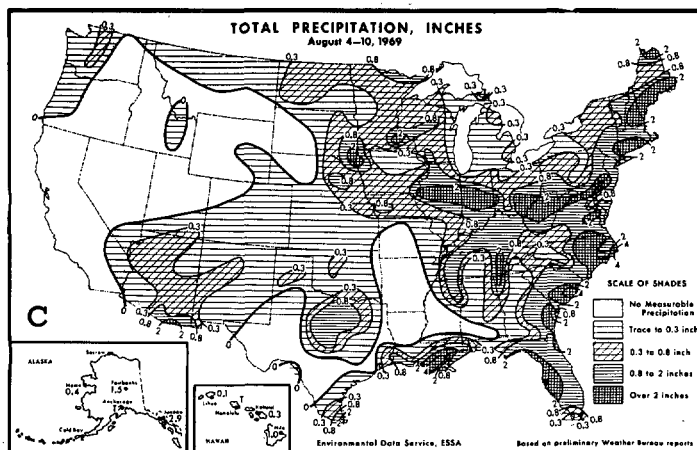
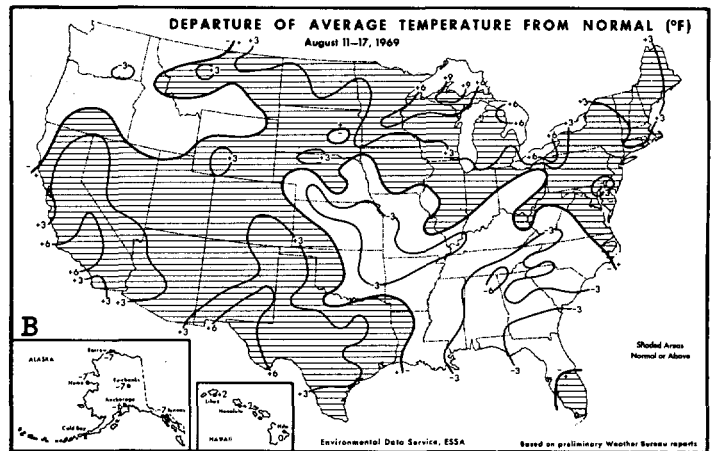
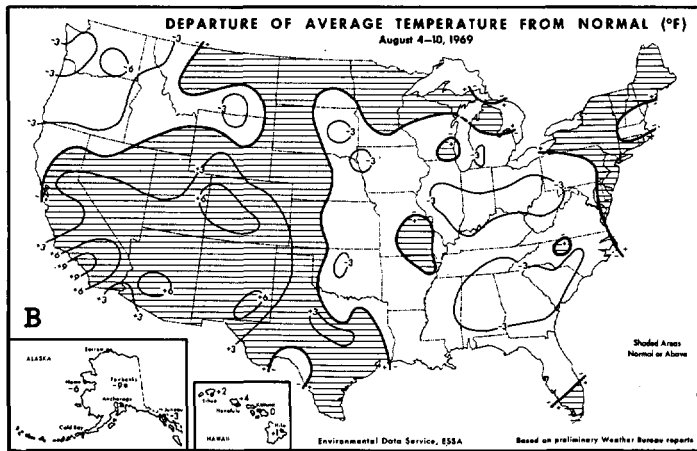
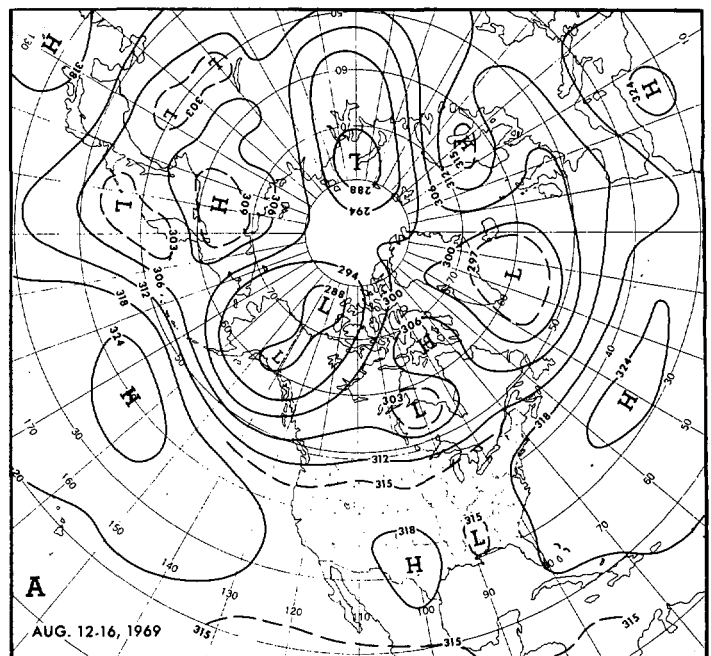
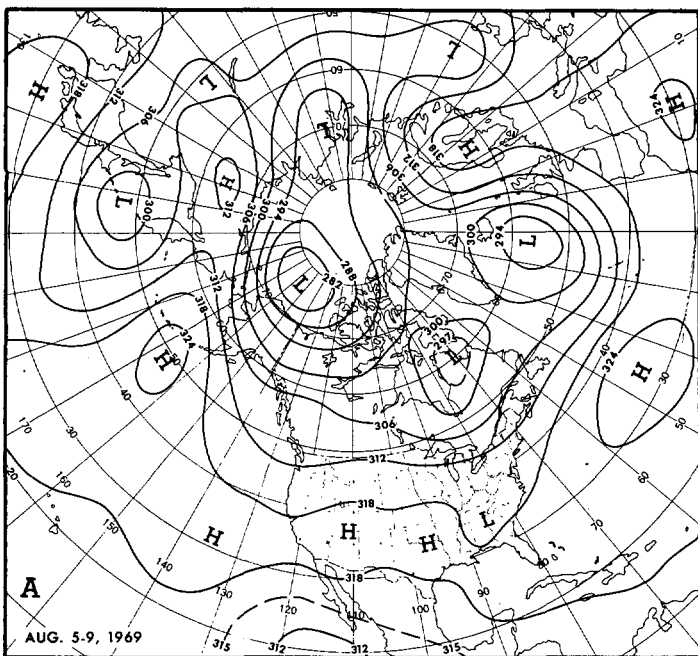


FIGURE 6.—(A) mean 700-mb contours (decameters) for Aug. 5-9, 1969; (B) departure from normal of average surface temperature ($^{\circ}\text{F}$) for the week of Aug. 4-10, 1969; (C) total precipitation (inches) for Aug. 4-10, 1969; source for B and C, Environmental Data Service (1969).

in the circulation about a progressing short wave (fig. 8) and recurved sharply to the north on August 20. Tropical storm Eve formed east of Florida on August 25 and was identifiable for only 3 days. Francelia reached hurricane intensity on August 27 east of Trinidad and, moving on

FIGURE 7.—Same as figure 6, (A) for Aug. 12-16, 1969; (B) and (C) for Aug. 11-17, 1969 (source, Environmental Data Service, 1969).

a west-northwest track, struck British Honduras early in September.

In the Pacific, tropical storm Alice passed over eastern Japan on August 4, the same day that hurricane Doreen was charted off the western coast of Mexico. Doreen moved westward and dissipated. Typhoons Betty and Cora were first observed 15° to 20° east of the Philippines on August 5 and 15, respectively. Betty moved west-

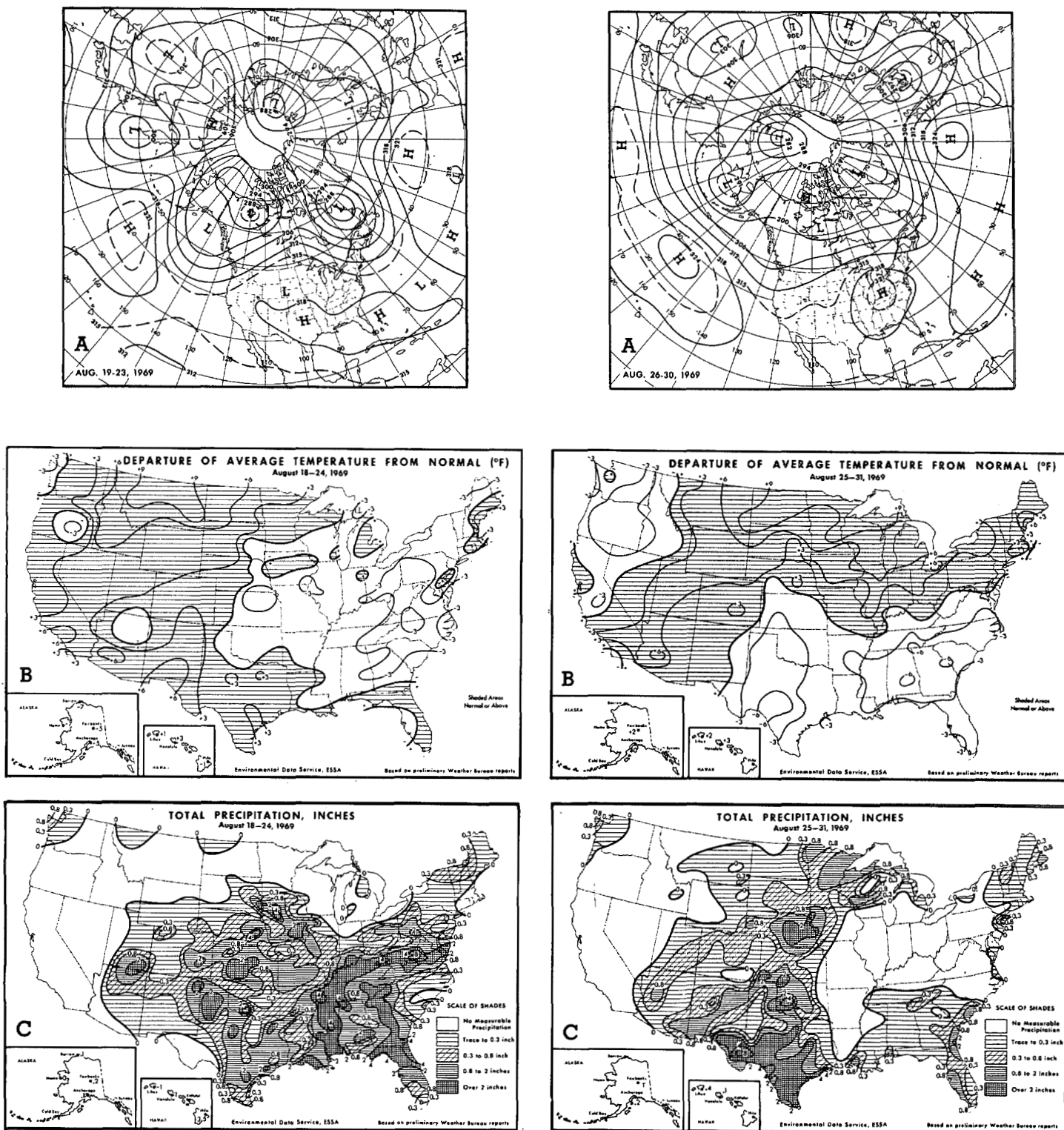


FIGURE 8.—Same as figure 6, (A) for Aug. 19-23, 1969; (B) and (C) for Aug. 18-24, 1969 (source, Environmental Data Service, 1969).

northwestward, crossing the China coast, while Cora recurved east of a deep trough in the westerlies and passed over southern and eastern Japan on August 21-23.

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FIGURE 9.—Same as figure 6, (A) for Aug. 26-30, 1969; (B) and (C) for Aug. 25-31, 1969 (source, Environmental Data Service, 1969).

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